APPARATUS FOR COLLECTING PARTICULATE MATERIAL

This invention relates to an apparatus for collecting particulate material such as dust/debris.

For certain processes, such as the use of an escalator-type conveyor in a public arena, the collection and disposal of accumulated dust, oil, debris etc., is a mandatory safety requirement, to minimise potential fire hazards. Accumulated debris naturally falls off the underside of the conveyor and needs to be collected and contained. This objective is usually achieved by fitting static, open-topped, dust collection trays, to the underside of the conveyors. Such trays are well known and there are many types of trays for numerous types of applications. This type of arrangement satisfactorily achieves the aim of collecting the dust and debris. However, in order to minimise fire hazards, and to ensure that fire safety regulations are not breached, it is required that, the trays receive regular, manual inspection and manual cleaning. This is expensive, in terms of time and labour, and sometimes the accepted fire risk levels are still exceeded. The cleaning operators are also exposed to regular contact with, potentially, harmful substances, from the accumulated dust oil debris etc.

The objectives of this invention are to:

1) Reduce the time and costs involved in inspecting and cleaning the collection tray.

2) Reduce the levels of fire risks, due to the accumulation of un-cleared dust/debris.
3) Reduce the exposure levels of the cleaning operators to potentially harmful substances.

According to a first aspect of this invention there is provided an apparatus for collecting particulate material comprising a collection tray, a fire resistant collection reservoir associated with said collection tray, and means for moving particulate material from said collection tray into said fire resistant collection reservoir.

Preferably, said reservoir is a container having a selectably operable lid.

Advantageously, said reservoir includes a removable collection unit.

Conveniently, said reservoir is located beneath one end of said tray.

Advantageously, said moving means include a motor driven scraper carriage unit which includes scraper blade means arranged to reciprocatingly move particulate material from an inside base portion of said tray and into said reservoir.

Preferably, when said scraper blade means is positioned above said reservoir, means are provided for opening said reservoir lid so that particulate moved by said blade is deposited into said reservoir.

In one embodiment, the means for opening said reservoir lid includes a pivotal lid having an abutment member arranged to be contacted by a member attached to said scraper carriage unit for causing said lid to pivotally open.

In an alternative embodiment, the means for opening said reservoir lid includes a pivotal lid arranged to be opened and closed by electro-magnetic means activatable by scraper carriage unit position detecting means.

Preferably, said electro-magnetic means is an electrical solenoid coupled with said lid.

Advantageously, there is provided detector means to determine the open and closed states of the lid and control means for controlling motion of said moving means whereby, if said lid fails to open or close, movement of said moving means is terminated.

Advantageously, when said scraper blade means is above said reservoir and said lid is open, means are provided for cleaning the scraper blade means, whereby particulate and dirt therefrom is deposited into said reservoir.

Preferably, when said scraper blade means reciprocatingly re-traverses along said tray away from said reservoir, means are provided for closing said reservoir lid and for lifting said scraper blade means away from said inside base portion of said tray so that particulate is not moved in a direction away from said reservoir.

Advantageously, when said scraper blade means is arranged to reciprocatingly move particulate material toward and into said reservoir, means are provided for ensuring rigidity of said scraper blade means and, preferably, said means are provided for maintaining said scraper blade means orthogonally to the inside base portion of said tray.

Preferably, means are provided for limiting the range of motion of said moving means.

Advantageously, said moving means is controllable by timer means to effect reciprocation of said moving means.

According to a second aspect of this invention there is provided a method of collecting particulate material including the steps of providing a collection tray into which particulate material is deposited, arranging a fire-resistant collection reservoir to be associated with said collection tray, said fire-resistant collection reservoir having a lid, including the steps of providing means for moving particulate material toward said fire-resistant collection reservoir, opening the lid of said reservoir and depositing said particulate into said reservoir.

Preferably, the method further includes the step of lifting said moving means, moving said moving means away from said reservoir and closing said lid.

Thus, this invention provides a time-controlled, automatic, mechanised apparatus having a particulate (dust/debris) collection tray with a combined fire resistant collection unit (reservoir). The accumulated dust/debris within the collection tray is automatically moved into a fire- proof collection unit. This is achieved by utilising an automatic, timed, mechanically driven, scraper device, which is located within the dust tray. The scraping process, along the tray, automatically engages, and leaves secure, the fire resistant collection unit, into which the scraped dust, debris, oil, grease etc. is deposited. The fact that the collection unit is fire resistant means that the accumulated dust/debris etc. can be kept safely within it, which means it need only to be emptied at much longer intervals. Thus the tray is regularly cleaned via an automatic timed mechanical device, and the accumulated dust/debris, needs clearing from site less frequently; thereby achieving the objectives as identified above.

Preferably the tray and components will be made of fire resistant and/or fireproof materials. The size and dimensions of the tray determined to suit the size, and appropriate collection area, of the conveyor it is to be fitted to.

The invention will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1 shows a perspective view of an apparatus in accordance with this invention when viewed from above, with the dust tray lid 32 in position,

Figure 2 shows a perspective view of an apparatus in accordance with this invention when viewed from above, with the dust tray lid removed for clarity,

Figure 3 shows a diagrammatic side view of a portion of the apparatus in one operational position,

Figure 4 shows a diagrammatic side view of a portion of the apparatus with a debris collecting hopper lid open and scraper blade approaching a debris deposit zone into a removable collection tray,

Figure 5 shows a diagrammatic side view of a portion of the apparatus in another operational position thereof,

Figure 6 shows a diagrammatic side view of the apparatus in which the scraper blade has dropped off the end of a scraper lift guide as it returns to its starting and finishing position for each complete cycle of clean,

Figure 7 shows an end view of the apparatus in the direction of arrow-headed line C shown in Figure 1,

Figure 8 shows an enlarged, detailed view of the left hand side of Figure 7,

Figure 9 shows an enlarged, detailed view of the apparatus, demonstrating the position and fixing arrangements for a debris-collecting hopper,

Figure 10 shows an enlarged detailed front view of the scraper blade,

Figure 11 shows in diagrammatic form a detailed view of a portion of an alternative embodiment, and

Figure 12 shows in diagrammatic form a partial side view of the embodiment shown in Figure 11 in a different operational position thereof.

In the Figures like reference numerals denote like parts.

It is to be understood that in the drawings, dust tray side panels where required or desired have been removed for clarity.

Figure 1 shows the apparatus viewed from above and fitted with a dust tray lid **32**.

The tray lid **32** has angled flanges sloping in towards the base of the dust tray **1**. The flanges of the tray lid **32** are angled to achieve three objectives:-

To protect and prevent debris/dirt build up over the areas which cannot be cleaned by the movement of the scraper blade **24** i.e. those areas at the ends and immediate sides of the tray **1**.

To direct dust/debris into the base of the tray **1**

To minimise any dust/debris build up on the tray lid **32**.

Figure 2 shows the apparatus with the tray lid 32 removed.

The main body of the apparatus is made of a steel tray 1. The tray 1 can be free standing on a proprietary support, below a selected debris deposit/catchment area of the conveyor or mechanical item which, requires the need to have a dust/debris collection unit. Alternatively it can be attached to the underside of the conveyor or mechanical item by utilising an L-shaped bracket 35 and proprietary fixings to suit.

Attached externally to the tray 1 are three items:

The first external item is the dust tray lid 32 (shown in Figure 1) which is secured in place by dust tray lid fixing brackets 34.

The second external item is a dust/debris hopper collection unit 21, which has an inner removable tray 23 and a hinged outer door 22. The hopper debris collection unit 21 is attached to the underside of the dust tray 1 by any suitable means and extends across an opening in the base of the tray 1. This opening in the tray base is covered with a pivotal hopper lid 18.

The third external item is an electronic control unit 3 attached to the front end of the tray 1 (The control unit 3 can be positioned to the side or separately to the tray 1 if necessary.) The function of the control unit 3 is to control the timing and the stopping and starting of

an electric motor 2, to which it is connected by a control cable 36.

The electric motor 2 operates a motor drive sprocket 5 which in turn operates a drive chain 44 which then operates a front axle drive sprocket 45 causing the front axle 4 to rotate in an associated bearing housing 6. The turning movement of the front drive axle 4 also turns scraper carriage chain sprocket 8 which in turn operates a scraper carriage chain 37 which rotates between the scraper carriage chain sprocket 8 and a scraper carriage tension axle sprocket 17.

The scraper carriage chain 37 is attached to a scraper carriage 7 with chain fixing pins 12. The scraper carriage 7 is then propelled forwards and backwards along a scraper carriage guide rail 9 on two opposed scraper carriage guide wheels 46 (shown in Figure 3) which, are fixed to the scraper carriage 7 by respective scraper guide wheel fixing bolts 47.

Figure 3 shows a side view of the device with the scraper blade 24 travelling from left to right as shown by arrow-headed line A. The scraper blade 24 is preferably made of metal with a rubber or plastics lateral bottom edge which travels sufficiently closely (a few microns) to the bottom of the tray to sweep small particles therefrom.

Figure 3 shows the scraper carriage 7, moving on its carriage guide wheels 46, as it travels along the carriage guide rail 9. Also shown are front and back

limit switches **13F** and **13B** respectively which are connected to the control unit **3** by electrical cabling (not shown for clarity) and are activated by a limit switch actuator **33** mounted on guide rail 9. The activation of the limit switches **13F** and **13B** signifies to the control unit the position of the scraper carriage **7**. The control unit is pre-programmed to stop and start the motor drive unit **2** in a forward or reverse mode dependant on which limit switch is activated. This process in conjunction with any pre-set timings controls the start, finish and number of cleaning cycles for the scraper cleaning mechanism.

The scraper blade **24** is maintained to be substantially orthogonal to the base of the tray **1** as it travels along the scraper guide rail **10** thereby allowing the blade to scrape any debris along in front of it.

Figure 4 shows the process of activation of a pivotal hopper lid **18**, the cleaning blade **25** and the limit switch **13B**.

A roller **30** is rotatably attached by a bracket to the scraper carriage **7** for use in pivoting the lid **18**.

As the scraper carriage unit moves from left to right, as shown in Figure 3, the roller **30** engages a hopper lid abutment **19** which causes the hopper lid **18** to pivot upwards on a pivot pin **20**. The movement of the scraper carriage from left to right also moves the scraper blade **24** over the opening in a base of the tray **1**. This allows any built up debris in front of the scraper blade **24** to

fall into the removable inner tray 23 of the hopper unit 21. Attached to the front of the scraper blade is a sprung moveable cleaning blade 25. As the scraper carriage moves forward, the top of the cleaning blade 25 engages a tapered cleaner blade wedge 29 which forces the cleaning blade down on its spring 27. The downward movement of the cleaning blade 25 scrapes any stubborn residue off the scraper blade 24 into the removable collection unit 23 below. As the scraper reaches the end of its forward cleaning cycle the limit switch 13B is activated by the limit switch actuator 33 which causes the control panel to stop the electric motor and to put it into reverse mode ready for the return leg of the cleaning cycle. In the event that the limit switch 13B fails to activate, the leading carriage guide wheel 46 is prevented from over-running the guide rail by coming into contact with a carriage guide end stop 38. This action would cause an overload in the motor unit 2 which would be sensed by the electronic control unit 3 which would then turn off the motor.

Figure 5 shows a side view of the scraper 24 moving back along the dust tray 1 from right to left in the direction of arrow-headed line B away from the hopper debris collection unit 21 and engaging a scraper lift pivot 11.

Figure 5 shows the hopper lid operating roller 30 having disengaged from the hopper lid abutment 19 as it moves along with the scraper carriage 7 away from the hopper collection unit 21. This movement in the opposite direction allows the hopper lid 18 to pivot back down into its closed position and the cleaning blade 25 to

disengage from the taper wedge **29** and return to its normal position utilising the spring action of the cleaner blade spring **27**.

As the scraper blade moves along from right to left it engages a scraper lift pivot **11**. The scraper blade **24** is designed with a notch **48** in each end (as shown in Figures 7 and 8) which allows it to travel along the scraper lift guide rail **10** in a substantially vertical position with respect to the base of the tray **1** when travelling in the cleaning direction from left to right, as shown by arrow-headed line A. However on the return leg of the cleaning cycle it is not considered preferable to be able to scrape/drag any residue debris away from the hopper unit **21** as this could cause an unacceptable build up of dirt/debris on the reverse side (downstream of the cleaning side) of the scraper blade **24**. To avoid this event the scraper blade is designed to hinge in one direction (counter clockwise in Figure 5) utilising a scraper hinge **28**. On the return leg of the cleaning cycle from right to left (in the direction of arrow-headed line B), when the scraper blade **24** engages the scraper lift pivot **11**, the scraper blade **24** is forced to hinge counter clockwise upwards, and the scraper blade side notches **48** (shown in Figures 7 and 8) do not engage the scraper lift guide rail **10**. This action then forces the scraper blade to travel along in a raised hinged position on top of the scraper guide rail **10** and thus it cannot scrape or cause build up of debris on the reverse side of the scraper blade **24**.

Figure 6 shows the scraper blade **24** having dropped off the end of the scraper lift guide rail **10** into a vertical position as it returns to its starting and finishing position for each complete cycle of clean.

The scraper blade **24** is assisted back into the vertical position by the contracting action of a scraper blade spring **26**. As the scraper carriage **7** reaches the start finish point of its cleaning cycle the limit switch actuator **33** will engage the limit switch **13F** which will initiate another pre-programmed set of instructions from the control panel **3**. These instructions will either continue or end the cleaning cycle until the programme timer tells the control panel to restart the cleaning cycle. Once again the scraper carriage guide **7** is prevented from excess travel by a carriage guide end stop **38a**.

FIGURE 7 shows a cross section of the device viewed from the end of the control unit **3**

This view shows opposing sides of the device arranged with an inter-connecting rod **31** between the two scraper carriages **7**. Also shown is the scraper blade notch **48** notch at both ends of the scraper blade **24**. It can be seen that the scraper notch **48** is in line with the scraper guide rail **10** and it is this notch which allows the scraper blade **24** to travel in a substantially vertical orientation along the scraper guide rail **10** and holds the blade in a substantially vertical direction when moving in the direction of arrow-headed line A.

Figure 8 shows a detailed left hand cross section of Figure 7 (scraper carriage chain **37** on scraper carriage sprocket **8** omitted for clarity).

Figure 8 shows the scraper blade hinge **28** attached to the scraper carriage **7** and scraper blade **24** via bolt fixings **40**. Within an end portion of the scraper carriage **7** are large holes **41**, which allow clearance for bolt fixings which attach the scraper hinge **28** to the scraper blade **24** through the lower bolt holes **40**. This clearance permits the scraper hinge **28** to be mounted substantially flush against, but not past, the vertical of a back plate of the scraper carriage **7**. This, therefore, allows the scraper blade **24** to maintain a substantially vertical position during the forward cleaning cycle.

Also seen in Figure 8 are cleaning blade fixing bolts **42**, which are used to locate the cleaning blade **25** in slotted holes. The slotted holes within the cleaning blade **25** allow it to move up and down as it is pushed downwardly by the taper wedge **29** and pulled back up by the action of the cleaning blade spring **27**.

At a lower part of the Figure 8 can be seen a hopper fixing plate **39** to which the hopper **21** attaches.

Figure 9 shows a cross section view of the apparatus showing the position and fixing arrangements for the debris-collecting hopper **21**.

Figure 9 shows the hopper unit fixed onto the bottom of the tray **1** via fixing bolts through fixing plate screw holes **43** in the hopper fixing plate **39**.

Also shown in Figure 9 is the detail of a tension axle bracket **15**, which holds a tension axle **14** and is adjusted via a screw threaded tension axle adjuster **16**.

Figure 10 shows a front view of the scraper blade **24** with the fixing arrangement for the scraper blade hinge **28** and cleaning blade **25** in slotted holes on bolt fixing points **42**.

An alternative embodiment of the apparatus is shown in Figures 11 and 12. In this embodiment, the hopper lid **18** is opened and closed by an electro-mechanical solenoid **60**. The solenoid **60** is secured to the base of the tray by a solenoid bracket **61**. The moving portion of the solenoid **60** is attached to a lid counterweight **66** by a link member **62** attached to clevis members **63** which thereby pivotally attach the solenoid moving member to the counterweight **66**. The counterweight is secured to the hopper lid **18** by any suitable means and acts as a balance weight to assist the solenoid in opening the hopper lid **18**.

Operation of the solenoid **60** is controlled by the position of the scraper carriage **7**. As the scraper carriage **7** commences and finishes its traverse along the tray, so the carriage actuates limit switch **13F**. The limit switch **13F** in turn signals to the control unit **3** the start and finish sequence of the scraper carriage **7**.

At the start and finish sequence of the scraper carriage **7**, the control unit signals to the solenoid **60** to open and close the hopper lid **18** in a corresponding sequence, open on start, close on finish.

Position detecting switches **64, 65** are attached to the side of the tray **1** for determining the open or closed status of the hopper lid **18**. The switches **64, 65** are used to confirm that the hopper lid **18** is fully open or fully closed in an operational sequence to correspond with the start and stopping sequence of the scraper carriage **7**. The switches **64, 65** signal to the control unit **3** the position of the hopper lid **18** which must be open or closed in accordance with the start or finishing sequence of the scraper carriage **7**. If for any reason the switches **64, 65** detect that the hopper lid **18** is open or closed out of sequence with the movement of the scraper carriage **7**, then the control unit will stop drive to the scraper carriage **7**.

Figure 12 shows a portion of a side view of the alternative embodiment with the hopper lid **18** in an open position having been raised by the solenoid **60** and with the scraper blade **24** located over the removable inner tray **23**. This Figure also shows the hopper lid **18** engaging switch **64** which, in turn, indicates to the control unit **3** that the hopper lid is fully open.

The use of a solenoid avoids the requirement of the roller **30** and hopper lid abutment **19** of the first embodiment.

Although the limit switches **13B** and **13F** and the switches **64, 65** are shown as mechanical switches, it will be appreciated by those skilled in the art that these switches are simply used as position detecting devices and any other suitable form of position detecting device such as photo-optical transmitters and detectors or magnetic sensing devices may alternatively be employed.